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Serching for traces in the water and breaking the ice

We spent most of the last week in the ice. During this time, the main focus of our work was on the water column. With the CTD, we recorded data for the physical oceanographers and took water samples. Where ever the ice conditions permitted, we also used the Rectangular Mid-water Trawl (RMT) to catch krill. Despite the difficult ice situation, we were quite lucky and somehow managed to fulfill most of our alternative open water plan.
On a side note; the entire world discusses the meltdown of the polar ice caps and we complain that we suffer because of heavy sea ice conditions. How can that be? In the following, I would like to take a few moments to clarify this point: The ice conditions we are facing this year are indeed particularly severe for a large area of the northwest Weddell Sea. In Punta Arenas, I also met a colleague from Jena on his homeward journey from King George Island. He explained that the last winter was the coldest recorded there. It is, however, not the case that we now have to reconsider all our observations and conclusions on the impact of climate change. In the Antarctic region, the climate variability and hence the sea ice conditions show significant geographic and annual variability. West of the Antarctic Peninsula (we are now to the northeast off the Peninsula), the increase in annual mean temperatures has been significantly higher than the global average while average temperatures and sea ice conditions for the entire Antarctic waters remained about constant. This shows that our knowledge of the climate change, its reasons and implication is still incomplete and that we have to stay alert.
The tracer analyses research, on which people have worked intensively during the past week, also provides important insights in this topic. Olli Huhn, the tracer analyses team leader who is supported by his students Tim Hannemann und Martin Vogt from the University of Bremen, courteously provides the following contribution to this weeks report:
"We tracer-oceanographers from the Institute for Environmental Physics at the University of Bremen literally want to get on the trace of the ocean and its interplay with the ice shelves. In order to do so, we analyze the distribution of a variety of trace gases in the water column. These gases are called trace gases because they only occur in very small concentration -traces- in the water. Interestingly, with a second meaning, they can also be used to trace water masses back to their regions of origin. This is really nicely visualized by a drop of cream or milk in coffee. From where the drop enters the surface, small clouds of cream and coffee can be clearly traced as they disperse in the cup. In the oceans, the main difference is that the trace gases cannot be seen with the naked eye – but they can be analyzed! Noble gases, like helium or neon for example, are tracers for water masses that contain melt water from the underside of ice shelves. From the Larsen Ice Shelves, for example, noble gas enriched melt waters form important components of the Weddell Sea bottom


Fig. 1 Winch control room in twilight. In the lower left corner is the water sampler in action. © Yoshihiro Nakayama, AWI


Fig. 2 The title of this photo by Sara Thomas is "Reflexion". © Sara Thomas, University of Hawaii

water. This water mass plays an important role in the ventilation of the world's oceans. When systematically studied, tracer analyses can even predict the melting rates of the undersides of ice shelves. It is possible that these rates may increase as a consequence of global climate change. To analyze noble gas concentrations and compositions of water masses, we sampled the water column with a water sampler CTD at various depths. On board, we then took sub-samples from the water samplers. These subsamples were sealed airtight in glass vials for later lab analyses onshore. Due to the fact that helium can even diffuse through glass, we used copper pipes to store the samples for helium analyses. To remove air bubbles, we had to hit them with a hammer for a while before they were squeezed tight. We took additional samples for CFCs analyses. In the atmosphere CFCs contribute to the disintegration of the world's protective ozone layer, however, they are harmless in the oceans. For physical oceanographers they are even rather helpful. Wherever surface waters sink down to form new bottom waters, it carries dissolved CFCs, taken up from the atmosphere, with it. Comparing the CFC concentrations of the different water masses to the atmospheric CFC concentrations that have changed -predominantly increased - in the past, it is possible to recalculate the time when these waters have left the surface. In this way, CFCs can be used to determine the age of a water mass. First results from previous CFC studies show that the age of the Weddell Sea deep water has increased over the past 30 years. We are now interested in seeing if this aging process continues and what is causing it and if these changes are somehow connected to the climate-induced changes of the Larsen Ice Shelves."

At the end of this week, the major part of our work in the water column was successfully performed. In some parts, Polarstern had to break hard through the ice. In other places, she went through impressively thick but brittle ice like a knife cuts through butter. Now we see Joinville Island again in bright light in between blizzards and fog and will soon recommence our seabed sampling. One sampling routine replaces the other. In the meantime, at the "University Polarstern", students also have to sit their exams.

We are in good health and spirits. On behalf of all participants, I would like to send greeting to the people at home!

Julian Gutt